SYNOPSIS

Estimation of impulse waveform parameters (viz test voltage, front-time, tail-time) from digital data acquired during high voltage impulse tests, particularly, on transformers, cables and reactors pose some difficulties due to presence of superimposed oscillation and/or overshoot Solutions proposed so far show large scatter in estimated parameters This is because, procedures in IEC 60060-1 and IEEE Std-4 (originally formulated to suit manual evaluation) are somewhat ambiguous, inconsistent, and so difficult to convert into an algorithm Motivated by this, an EU funded project (involving five HV labs) was undertaken, whose objectives were-

1 Experimentally establish (for air, oil, XLPE and SF_6 media) a correlation between test voltage and the parameters of oscillation/overshoot, under different electric stress and polarity conditions
2 Consequently, propose a method for estimating test voltages, valid for all types of lightning impulses
3 Eventually, revise IEC 60060-1 and 61083-2, to eliminate inconsistency, empiricism and ambiguity

Obviously, goals set by the project group were quite remarkable The project finally resulted in a method (called '***k-factor***') for estimation of test voltage of impulses, and involved a filtering-based implementation Some details of k-factor method were published, on behalf of ***CIGRE WG 33-03*** in ***Electra,*** in October 2002, along with a recommendation for revision of IEC 60060-1 and 61083-2

Subsequently, drawbacks in k-factor method were found and reported in *Letter-to-the-Editor,* in ***Electra***, in April 2003, along with a response from the project group From these two publications (and other internal Working-Group documents), it emerges that the k-factor proposal contains infirmities and so is unacceptable However, these infirmities are somewhat masked in these publications, either due to brevity imposed or false logic being employed, thereby giving the method an artificial sense of acceptability

Until date, it is not certain, what the final version of k-factor method would consist of, and the steps involved in its implementation While on one hand, work still continues to resolve core

ıssues related to ıt, on the other hand, efforts are underway to ınclude ıt ınto ınternatıonal standards, ***perhaps, oblıvıous of ıts shortcomıngs***! In antıcıpatıon of such a revısıon, two reputed companıes sellıng HV ımpulse analysıs system have gone ahead to ınclude thıs method ınto theır exıstıng software, and aıe ready to sell ıt! Such a contrastıng scenarıo surely necessıtates a detaıled evaluatıon of k-factor method to enable ıdentıfıcatıon of ıts lacunae Thıs was the motıvatıon, as well as, the objectıve of thıs thesıs Thıs thesıs presents a detaıled analysıs based on an assessment of varıous aspects that have ınfluenced ıts formulatıon, namely,

- Experımental results, Treatment of breakdown data, A sıngle curve representıng behavıour of all dıelectrıcs, Myths and realıtıes about fılterıng, Issues ın fılter realızatıon, Resıdual and global fılterıng, etc

Specıfic attentıon ıs focused on matters related to ımplementatıon of k-factor method In fact, the very basıs of ımplementıng ıt as a 'fılterıng-operatıon' ıs strongly crıtıcısed and ıt ıs proved (by sımulatıon) that ıt can lead to ınconsıstencıes ın the defınıtıon of k-factor Thıs happens to be one of ıts major drawbacks Problems arısıng due to fılterıng a transıent and those associated wıth obtaınıng a sıngle mean-curve (by *Levenberg-Marquardt* algorıthm) ın 'resıdual fılterıng' scheme, are examıned Inconsıstency related to defınıtıon of overshoot arıses when processıng practıcal data, thereby questıonıng vıabılıty of resıdual-fılterıng scheme Supported by sımulatıons and studıes on practıcal data, answers to some ımportant questıons are attempted, namely,

1 ***Does k-factor method, per se, attaın the requırements expected of a standard method?***
2. ***Were ınıtıally set goals of removıng empiricism, ambıguıty etc actually achıeved?***
3 ***How the experımental k-factor data could be used more meaningfully?***

In final summary, ıt emerges that unless all ıdentıfıed drawbacks ın k-factor method are adequately resolved, ıt would be premature to recommend ıts adoptıon ınto IEC standards Detaıls are presented ın the thesıs